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The relationship between spontaneous eye blink rate and menstrual cycle phase in normal human females

Abstract

INTRODUCTION: A previous study has suggested that fluctuations in the blink rates of women not taking birth control pills may be related to fluctuations in estrogen and progesterone levels in the body.

SUBJECTS AND METHODS: Average blink rates of two women were measured for five minutes per day over a complete menstrual cycle.

RESULTS: The first subject showed a significant decrease in blink rates at ovulation and during the beginning of week 1. The second subject did the exact opposite and showed an increase in blink rate during ovulation.

DISCUSSION: The pattern of the first subject suggests that there may indeed be a relationship between hormone levels and blink rates, but more research needs to be done to support this hypothesis.

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**THE RELATIONSHIP BETWEEN SPONTANEOUS EYE BLINK
RATE AND MENSTRUAL CYCLE PHASE IN NORMAL
HUMAN FEMALES**

By
Gayleen Sakata, BS

A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove, Oregon
for the degree of
Doctor of Optometry
May 1996

Adviser:
Robert L. Yolton, OD, PhD

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THE RELATIONSHIP BETWEEN SPONTANEOUS EYE BLINK RATE AND
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Biography

Gayleen Sakata was born and raised in Waipahu, Hawaii. I began attending Pacific University in the fall of 1989, with the intention of entering the College of Optometry. My undergraduate degree, a Bachelor's in Visual Science, was completed in the spring of 1994. I entered optometry school in the fall of 1992 and will graduate with my doctor of optometry in the spring of 1996.

My future plans include providing quality comprehensive care to the best of my abilities to all of my patients. I would like to return home to Hawaii and establish myself there as a valuable and productive member of the community.

ABSTRACT

INTRODUCTION: A previous study has suggested that fluctuations in the blink rates of women not taking birth control pills may be related to fluctuations in estrogen and progesterone levels in the body.

SUBJECTS AND METHODS: Average blink rates of two women were measured for five minutes per day over a complete menstrual cycle.

RESULTS: The first subject showed a significant decrease in blink rates at ovulation and during the beginning of week 1. The second subject did the exact opposite and showed an increase in blink rate during ovulation.

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KEY WORDS

Blink, hormone, progesterone, estrogen, menstrual, ovulation, tears, rates, levels, menstruation, oral contraceptives

INTRODUCTION

Is there really a difference between the blink rates of males and females? In a previous study done by Yolton et al.,¹ this question was addressed and the effects of gender and birth control pill use on blink rates were tested. Fifty nine males and eighty four females, forty four of whom were taking oral contraceptives, were tested and their blink rates calculated. The results of this study did not show a significant difference between males and females not taking oral contraceptives. There was, however, a significant increase in the blink rates of females who were using birth control pills. In further considering the results from the women not taking oral contraceptives, an interesting possibility arose. The average blink rates of the females not taking pills showed a suggestive drop during week 2, specifically at ovulation, when estrogen levels in the body decreased significantly. From this observation, a suggestion was made that there may be a correlation between fluctuations in blink rates and hormone levels. This is the basis for the current study in which this relationship was evaluated.

The Normal Reproductive Cycle

As described in Guyton,² the two main hormones that are involved in the normal female reproductive cycle are estrogen and progesterone. At the beginning of the cycle, starting with day zero, estrogen level in the body is at it's lowest point. Progesterone is also being secreted, but at a lower concentration than that of estrogen. As the days within the cycle increase, so do both of the estrogen and progesterone plasma levels within the body. However, estrogen levels rise at a significantly higher than progesterone

levels. The increasing estrogen levels stimulate endometrial glands to grow and stromal cells to increase, ultimately causing the endometrial thickness to increase.

Approximately two weeks later, on about day 13, estrogen levels drop drastically to approximately the same level as the progesterone. This is when ovulation occurs and a developed ovum is released from the ovaries into the fallopian tubes. Following ovulation, progesterone levels increase in the same manner as estrogen does in the first half of the cycle. Estrogen levels also increase, but not by the same amount as progesterone.

During the second half, or secretory phase of the reproductive cycle, there is not much of a change in the proliferation of endometrial cells, but there is considerable swelling in the endometrium itself. The purpose for these endometrial changes is to prepare for healthy implantation of the ovum should fertilization occur. If fertilization does not occur, the progesterone level drops and menstruation occurs. During menstruation, a decrease in estrogen levels causes the uterine wall to contract, thereby causing the endometrial wall to slough off and decrease its thickness by 35 percent. There is also a 35 ml loss of both blood and serous fluid by the body. This occurs for approximately 5 days, during time which both estrogen concentrations remain low. By the end of menstruation, the endometrium has almost completely re-epithelized and bleeding has ceased. From this point, the cycle repeats itself and estrogen levels start rising once again.

Is there really a relationship between blink rates and estrogen levels in the body? Can fluctuations in estrogen levels affect the

rate at which females blink? Or is there some other factor that has an effect? To answer these questions, blink rates of females not taking oral contraceptives were measured on a daily basis and related to menstrual cycle phase.

SUBJECTS AND METHODS

Subjects

Two subjects participated in this study. Both were females, one age 23 years and the other age 24. The subjects were recruited by the examiner directly. Participation in this study was voluntary and no compensation was paid.

In order to qualify to for the study, the subjects had to be females between the ages of 19 and 32, in good health, and have a fairly regular menstrual cycle. Those who wore contact lenses (either full-time or part-time), were taking any form of birth control pills or estrogen, or were pregnant or lactating were excluded. Also excluded were those who had active allergies at the time, were sick, had any type of ocular infection, or were taking long term medications that could affect blink rates. The subjects also had to agree to use a Clearplan Easy™ ovulation kit^a midway through their menstrual cycle to determine when ovulation occurred.

To keep the participants from subconsciously altering their blink rates, they were told that their eye movements rather than their blink rates were being recorded. On this basis, informed consent was given by the two subjects for participation in the study.

Methods

Blink rates were determined by video taping each subject's eyes for 7 minutes per day seven days per week. Taping was done in

the same room, and the same lighting, and environmental conditions were used for all of the recordings. Data were collected during the latter half of winter and spring of 1995.

Each participant was asked before the daily taping process at what day they were on in their menstrual cycle. She was then seated in a chair in the exam room 2.0 M away from a flat 2.0 by 2.5 M screen covered by a plain white bed sheet to eliminate any distracting stimuli. The video camera that was used to gather the data was mounted on the wall at a 45 degree angle to the subject's line of sight to keep it as unobstructive as possible.

The first two minutes of each 7 minute session were used as an adaptation period and only blinks made during the next five minutes were counted from the video tape records. The mean blink rate per minute was found dividing the total number of blinks counted by 5. All data were analyzed by the same examiner. Incomplete blinks and lid twitches were not counted, and only full, complete blinks were taken into account. The camera was positioned to only record the subject's face, so counting blinks was not difficult.

This process went on daily for a month (or for a complete menstrual cycle, whichever came first). The taping was done at approximately the same time of day on each day.

At the midway point of the subject's menstrual cycle, she was asked to use a Clearplan Easy ovulation strip to determine the time of ovulation. The test doesn't determine if ovulation has occurred, but rather that it will occur during the next 24-48 hours. For use, the strip was inserted into the urine stream and turned blue if

ovulation was about to occur. This testing was started about four days before estimated ovulation time.

RESULTS

The graph relating blink rates to menstrual cycle day for subject 1 is shown in Figure 1. Her menstrual cycle length was 26 days long, menstruation starting at day 1, and ovulation occurring at day 15. Across the entire cycle, the mean blink rate was 11 blinks per minute.

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Insert Figure 1 About Here

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Subject 1 showed a general decrease in mean blink rate during the first week of the menstrual cycle during which menstruation was occurring. Blink rates on days 1 through 9 showed a relatively consistent mean blink rate of about 10 blinks per minute; the rate then increased slightly to about 12 blinks per minute until day 14. On day 15, when ovulation presumably occurred, the blink rate dropped to 8 blinks per minute and then rose again during the remainder of the cycle.

The blink rate versus cycle phase graph for subject 2 is shown in Figure 2. Her menstrual cycle duration was 27 days with ovulation occurring on day 16. Across the entire cycle, the mean blink rate was 16 blinks per minute. The pattern of blink rate changes with menstrual cycle phase as seen in subject 1 was not repeated in the data from subject 2. No significant decrease in blink rate was detected at the time of ovulation, and, in fact, the blink

rate for subject two increased at the time of ovulation.

Insert Figure 2 About Here

DISCUSSION

Do estrogen and progesterone levels have an effect on blink rates? If data from both subjects are taken into consideration, then the answer is no; it was not shown that hormone levels affect blink rates. However, it is difficult to explain why there is such a difference between the data from the two subjects. The first subject's blink rates followed the expected pattern, while the second subject's blink rates showed the exact opposite of the expected pattern. In essence, effects shown in the data from the two subjects seemed to cancel each other out. (Figure 3)

Insert Figure 3 About Here

Why such a difference? One possible explanation is that subject 2 had undergone radial keratotomy approximately 8 years prior to the time of the study. If blink rates are dependent on hormone levels, the radial keratotomy should have had no effect on the results of this study, but no other factors that might account for the differences between the subjects were revealed by the data collected in the study. It is possible, however, that the actual internal hormone levels in the subject 2 did not follow the textbook patterns and this might have distorted her blink rate data. A precise

daily assay of circulating hormone levels would have revealed this problem.

In summary, when the data from both subjects were combined, no correlation was found between the blink rates and the hormone levels associated with their menstrual cycles. However, subject 1 did show a suggestive decrease in blink rate at the time of ovulation and this result warrants further evaluation of the possible relationship between hormone levels and blink rates. Such a further evaluation should include significantly more subjects and a better method for assessing hormone levels

FOOTNOTES

- a. The Clearplan Easy™ One Step Ovulation Predictor is made by Whitehall Laboratories, New York NY.

REFERENCES

1. Yolton DP, Yolton RL, Lopez R, Bogner B, Stevens R, Rao, D. The effects of gender and birth control use on spontaneous blink rates. J Am Optom Assoc 1994; 65:765-70.
2. Guyton AC. Textbook of medical physiology. Philadelphia: Saunders 1966:1145-6

FIGURE CAPTIONS

Figure 1. Day of menstrual cycle versus blink rate for subject 1.

Figure 2. Day of menstrual cycle versus blink rate for subject 2.

Figure 3. Day of menstrual cycle versus blink rate for both subjects combined. To combine these data, data were shifted by one day for subject 2 to align the days of ovulation for both subjects.





